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(54) **CROSS-DOMAIN COMMUNICATIONS BETWEEN BROWSER WINDOWS**

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(51) **Int. Cl.**

G06Q 30/00	(2012.01)
G06Q 30/06	(2012.01)
G06F 17/00	(2019.01)
G06F 16/95	(2019.01)
G06F 16/951	(2019.01)

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CPC ***G06Q 30/0641*** (2013.01); ***G06F 16/95*** (2019.01); ***G06F 16/951*** (2019.01); ***G06F 17/00*** (2013.01); ***G06F 21/00*** (2013.01); ***G06Q 20/12*** (2013.01); ***G06Q 30/0253*** (2013.01); ***H04L 63/00*** (2013.01); ***H04L 67/02*** (2013.01); ***H04L 67/10*** (2013.01); *H04L 67/38* (2013.01)

(58) **Field of Classification Search**

CPC G06F 17/30; G06F 17/00; G06F 16/95; G06F 16/951; G06Q 30/06; G06Q 30/0641

See application file for complete search history.

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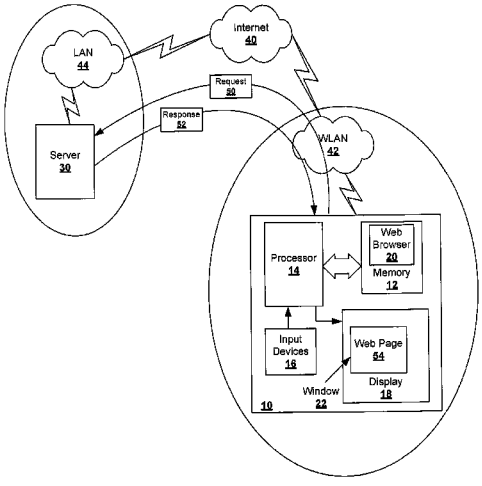
(57) **ABSTRACT**

A computer process enables a target window associated with a first domain to receive a message from a child window associated with a second domain. The message is passed using an iframe that is created within the target window. The process may, for example, be used to relay information entered by a user into the child window to the target window.

22 Claims, 9 Drawing Sheets



(51) **Int. Cl.**

G06F 21/00	(2013.01)
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G06Q 30/02	(2012.01)
H04L 29/08	(2006.01)

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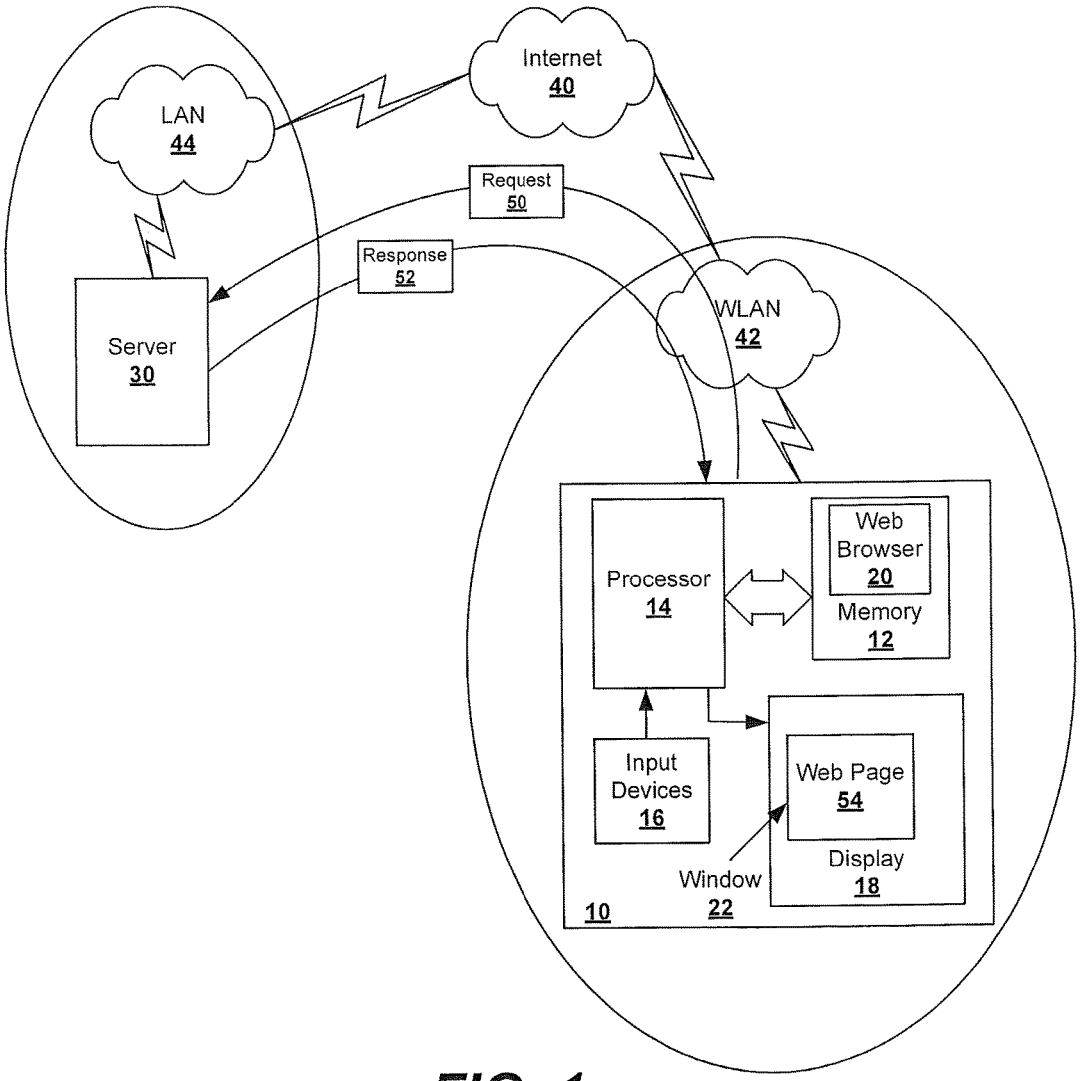
Internet
40
LAN
44
Request
50
Response
52
Server
30
WLAN
42
Processor
14
Web
Browser
20
Memory
12
Input
Devices
16
Web Page
54
Display
18
Window
22
10

FIG. 1

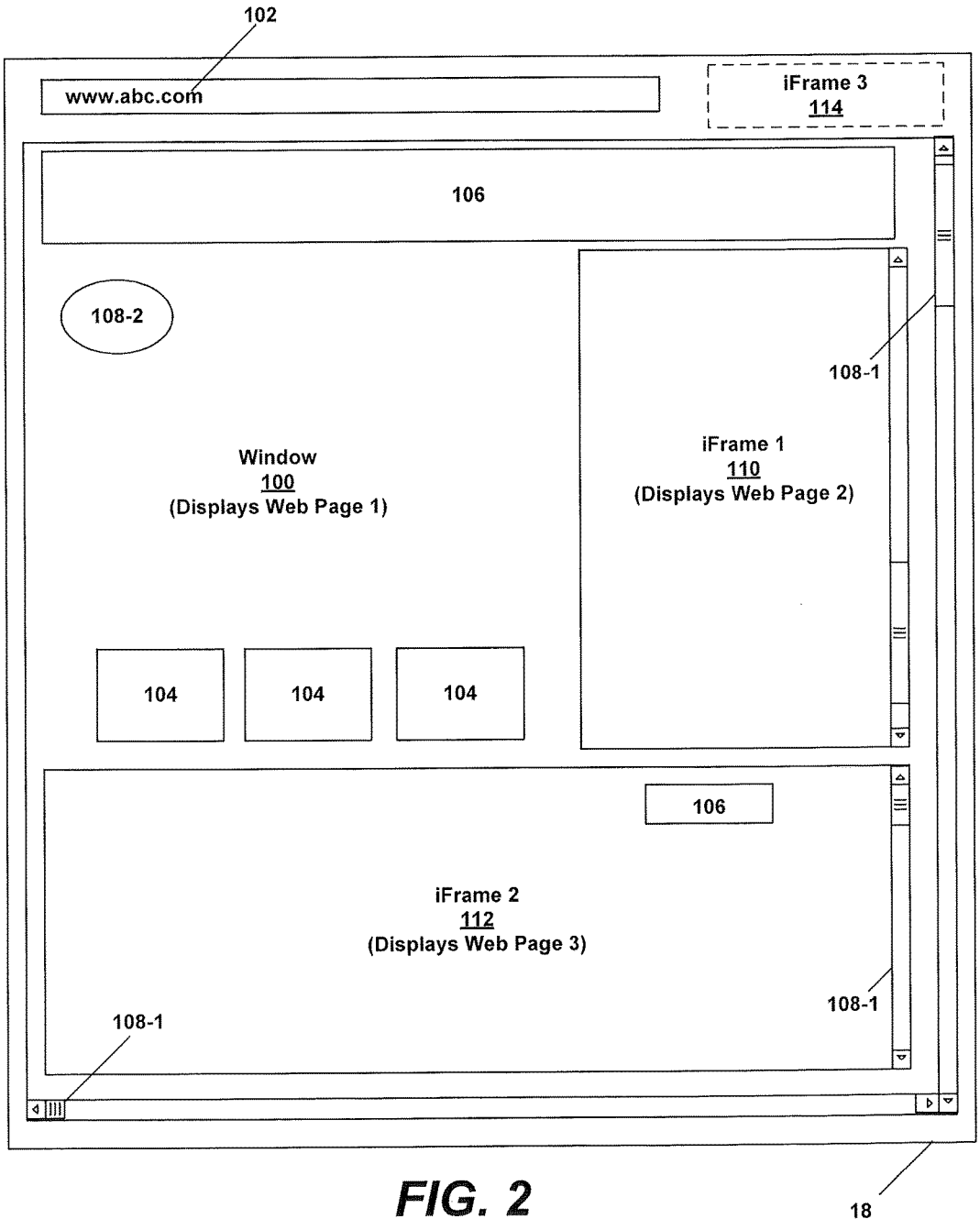
102
www.abc.com
iFrame 3
114
106
108-2
108-1
Window
100
(Displays Web Page 1)
iFrame 1
110
(Displays Web Page 2)
104
104
104
106
iFrame 2
112
(Displays Web Page 3)
108-1
108-1
18

FIG. 2

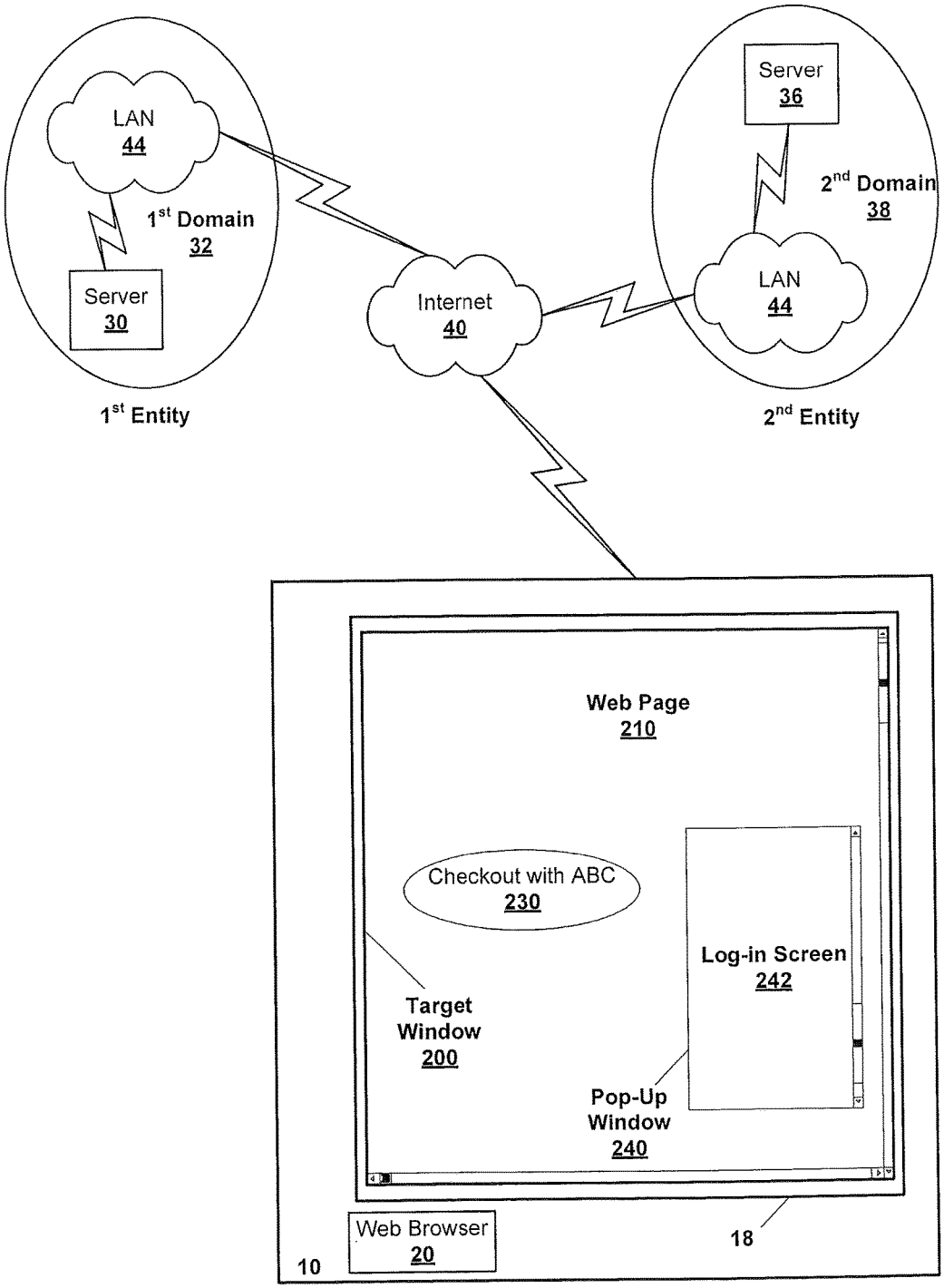
LAN
44
1st Domain
32
Server
30
1st Entity
Internet
40
Server
36
2nd Domain
38
LAN
44
2nd Entity
Web Page
210
Checkout with ABC
230
Log-in Screen
242
Target
Window
200
Pop-Up
Window
240
Web Browser
20
10
18

FIG. 3

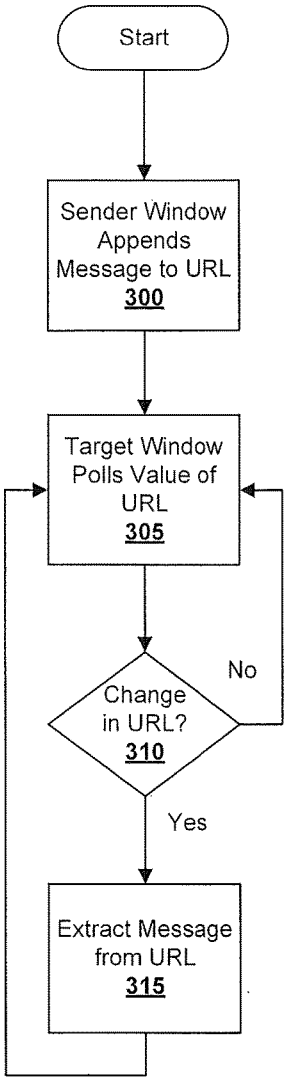
Start
Sender Window Appends Message to URL
300
Target Window Polls Value of URL
305
Change in URL?
310
No
Yes
Extract Message from URL
315

FIG. 4

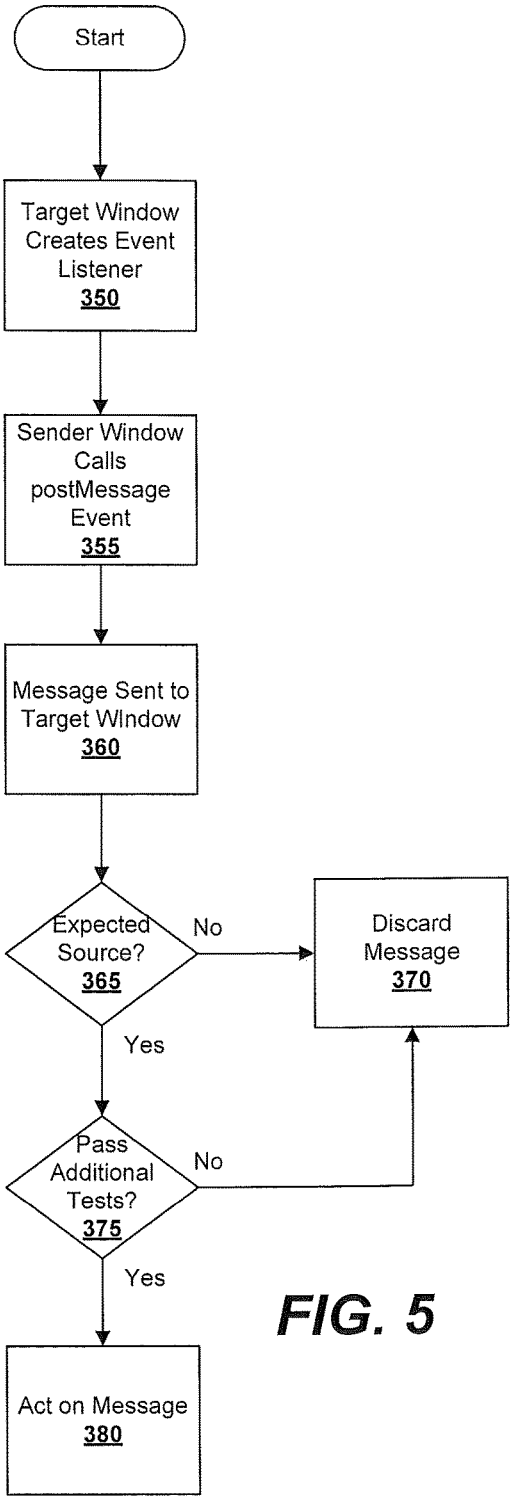
Start
Target Window Creates Event Listener
350
Sender Window Calls postMessage Event
355
Message Sent to Target Window
360
Expected Source?
365
No
Discard Message
370
Yes
Pass Additional Tests?
375
No
Yes
Act on Message
380

FIG. 5

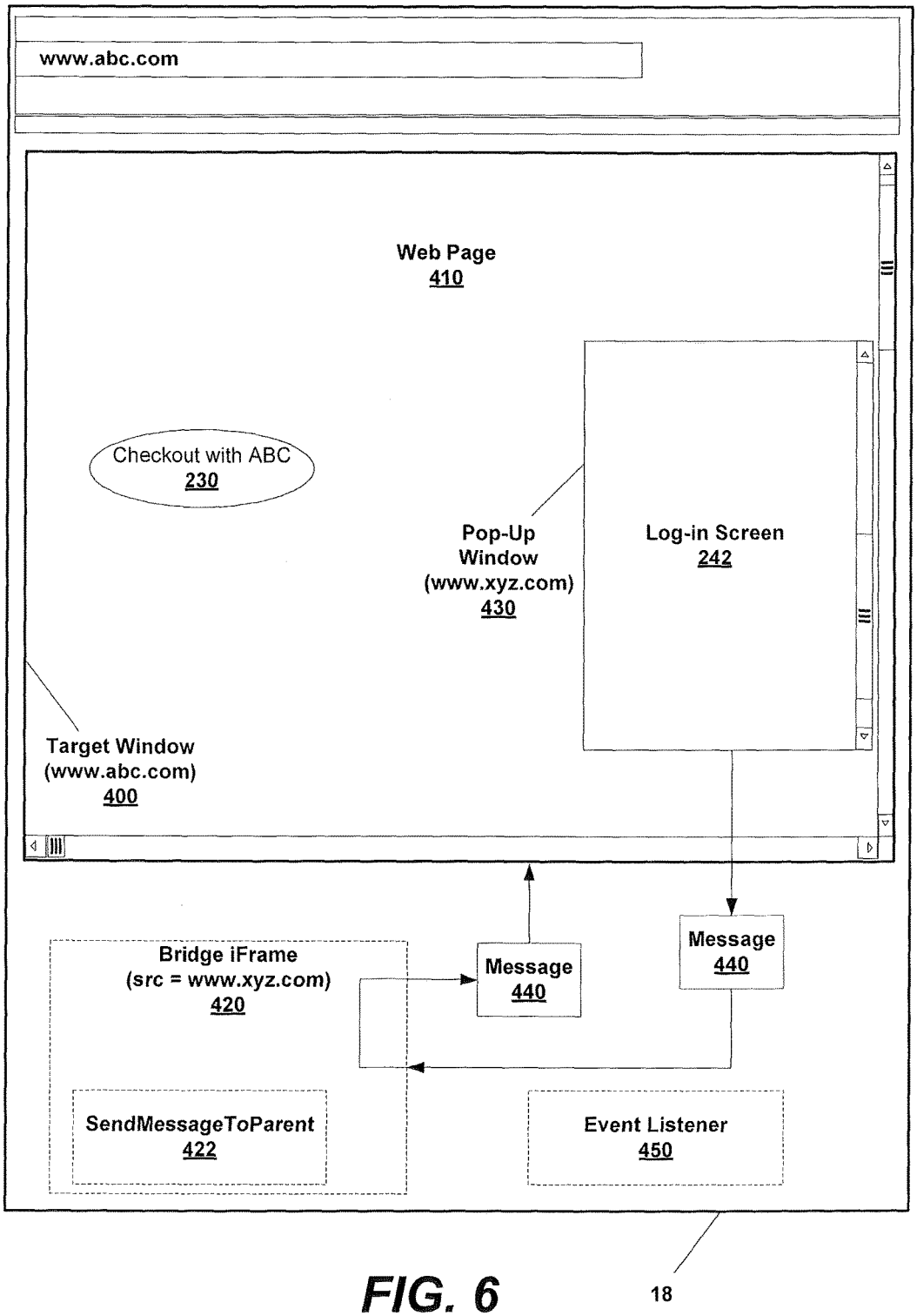
www.abc.com
Web Page
410
Checkout with ABC
230
Pop-Up
Window
(www.xyz.com)
430
Log-in Screen
242
Target Window
(www.abc.com)
400
Bridge iFrame
(src = www.xyz.com)
420
Message
440
Message
440
SendMessageToParent
422
Event Listener
450
18

FIG. 6

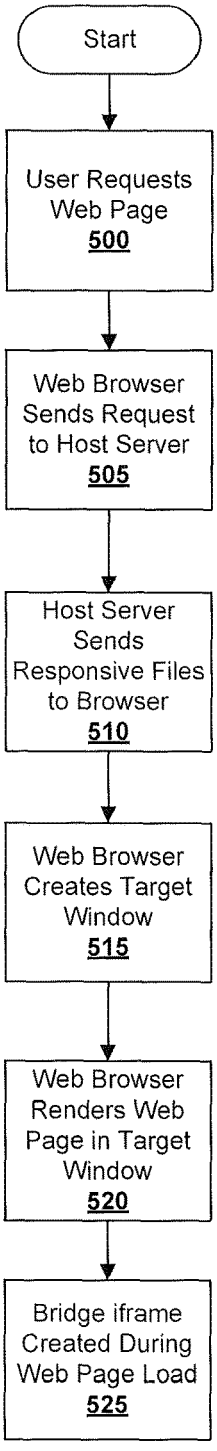
Start
User Requests Web Page 500
Web Browser Sends Request to Host Server 505
Host Server Sends Responsive Files to Browser 510
Web Browser Creates Target Window 515
Web Browser Renders Web Page in Target Window 520
Bridge iframe Created During Web Page Load 525

FIG. 7

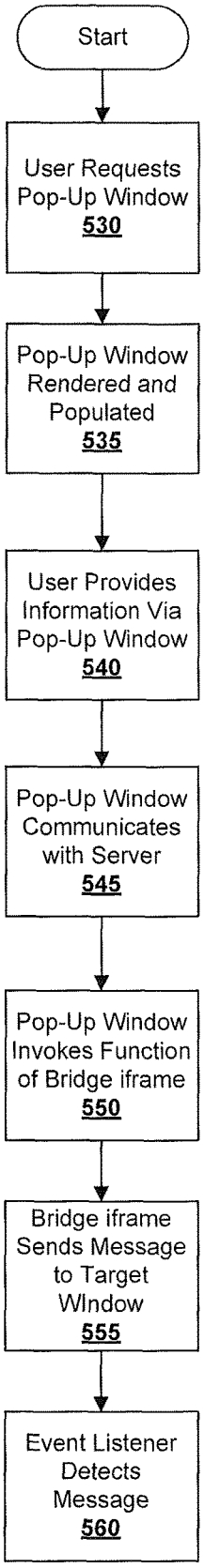
Start
User Requests Pop-Up Window 530
Pop-Up Window Rendered and Populated 535
User Provides Information Via Pop-Up Window 540
Pop-Up Window Communicates with Server 545
Pop-Up Window Invokes Function of Bridge iframe 550
Bridge iframe Sends Message to Target WIndow 555
Event Listener Detects Message 560

FIG. 8

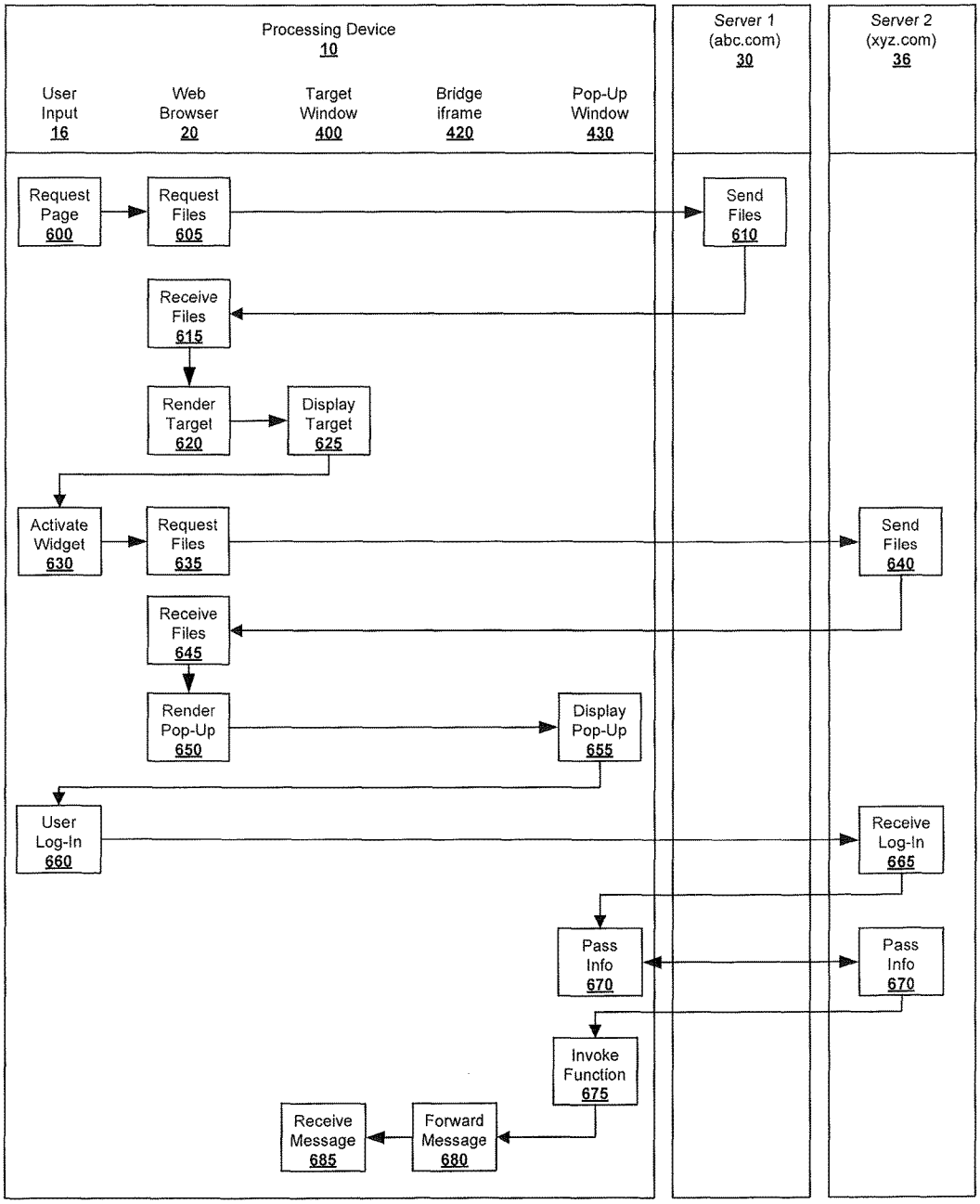
Processing Device
10
User Input
16
Web Browser
20
Target Window
400
Bridge iframe
420
Pop-Up Window
430
Server 1
(abc.com)
30
Server 2
(xyz.com)
36
Request Page
600
Request Files
605
Send Files
610
Receive Files
615
Render Target
620
Display Target
625
Activate Widget
630
Request Files
635
Send Files
640
Receive Files
645
Render Pop-Up
650
Display Pop-Up
655
User Log-In
660
Receive Log-In
665
Pass Info
670
Pass Info
670
Invoke Function
675
Receive Message
685
Forward Message
680

FIG. 9

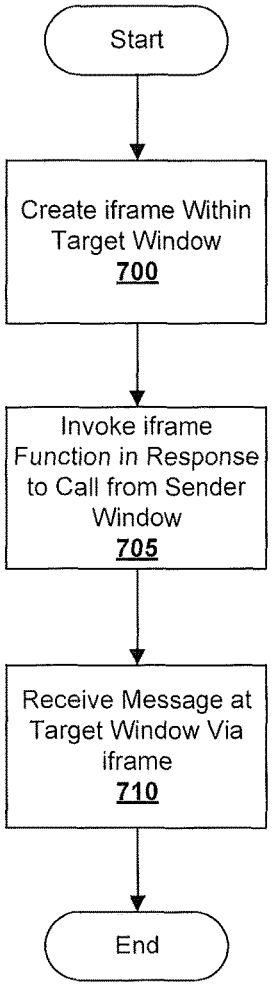
Start
Create iframe Within Target Window
700
Invoke iframe Function in Response to Call from Sender Window
705
Receive Message at Target Window Via iframe
710
End

FIG. 10

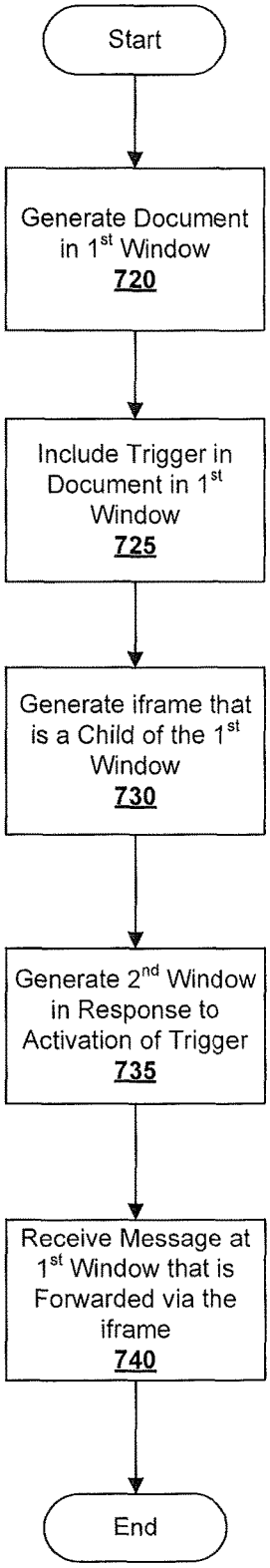
Start
Generate Document in 1st Window
720
Include Trigger in Document in 1st Window
725
Generate iframe that is a Child of the 1st Window
730
Generate 2nd Window in Response to Activation of Trigger
735
Receive Message at 1st Window that is Forwarded via the iframe
740
End

FIG. 11

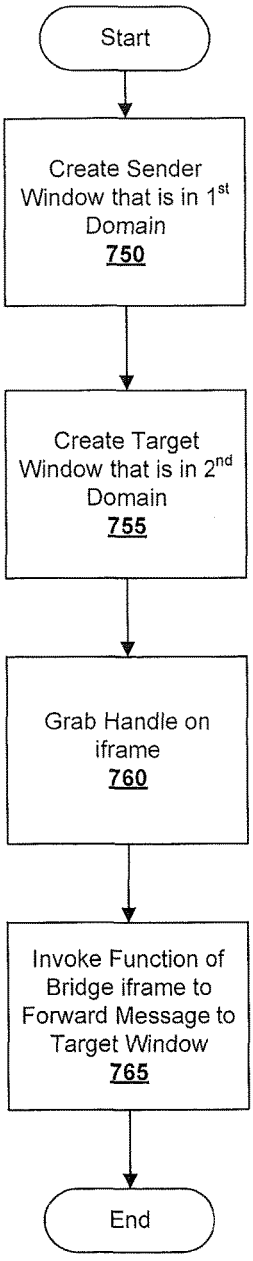
Start
Create Sender Window that is in 1st Domain
750
Create Target Window that is in 2nd Domain
755
Grab Handle on iframe
760
Invoke Function of Bridge iframe to Forward Message to Target Window
765
End

FIG. 12

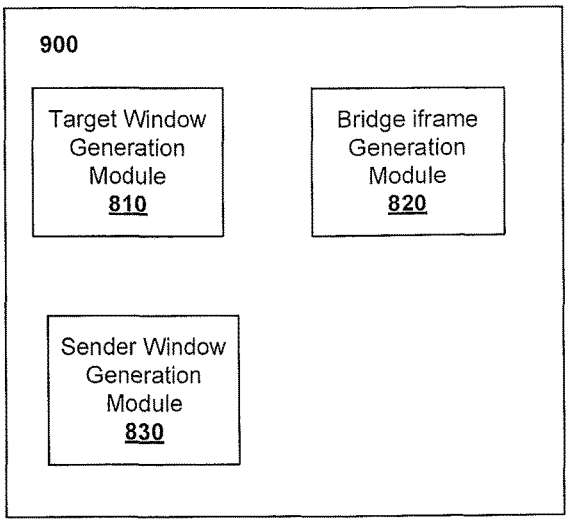
900
Target Window Generation Module
810
Bridge iframe Generation Module
820
Sender Window Generation Module
830

FIG. 13

CROSS-DOMAIN COMMUNICATIONS BETWEEN BROWSER WINDOWS

PRIORITY CLAIM

This application is a continuation of U.S. application Ser. No. 13/092,695, filed Apr. 22, 2011, which is hereby incorporated by reference.

BACKGROUND

Web browser programs are computer software applications that are designed to retrieve information over the Internet, and to then render the retrieved information on a display device where it can be accessed and reviewed by a user. A user may request information such as a web page from a remote server over the Internet by inputting an address in the form of a Uniform Resource Locator ("URL") into the web browser program, which causes the web browser program to request one or more files from the remote server that are needed to construct the web page and render it on the user's display device. The requested files are usually extensible mark-up language ("XML") or hyper-text markup language ("HTML") files. Upon receipt of the requested file(s), the web browser program renders the information (e.g., a web page, a form, a video, etc.) in an appropriate format on the user's display device, typically in the form of an XML or HTML document.

The web browser program usually displays the requested XML or HTML documents to the user within one or more windows on the user's display device. A window refers to a portion of the display device that is typically framed by borders and which presents the document(s) rendered therein in a manner that appears to be independent of the rest of the display. Windows can be divided into or include one or more "iframe" sub-elements (which sometimes are referred to as simply "frames"), each of which may operate as a separate, independently controllable sub-window that may, for example, contain its own HTML or XML document(s). The source ("src") address of an iframe identifies the source of the content of the iframe (e.g., the URL of the contents of the iframe). An iframe can be embedded in a window such that it is not visible on the user's display device. A window or iframe is considered to be "in" or "within" or "associated with" (which terms may be used interchangeably herein) the "domain" of the server or other processing device that supplied the content to the window, where the "domain" refers to a common name under which the server supplying the content and various other network devices are organized (e.g., abc.com).

Pop-up windows, dialog boxes and other windows or iframes are routinely generated on a display device that are located on top of, or adjacent to, an underlying web browser window or iframe. In certain situations, it may be desirable to allow, for example, a pop-up window or iframe to communicate with an underlying web browser window or with widgets or other objects contained within the underlying web browser window. Unfortunately, allowing a first window or iframe to alter the contents of a second window or iframe can raise security concerns, particularly if the windows/iframes at issue are not populated with information that originated from the same source. In particular, so-called cross-site scripting attacks have become increasingly common. A cross-site scripting attack refers to the malicious injection of JavaScript or other computer code into a web page that is being viewed by other users, where the code is designed to insert advertisements, steal sensitive information or commit other annoying or malicious acts. In order to combat such cross-scripting attacks, many web browser programs now restrict or prevent a window that is in a first domain from communicating with or altering the contents of windows that are in different domains, even in cases where the windows are not hostile to each other. Because of these security features, various "cross-domain" communications (i.e., where a window/iframe in a first domain communicates with a window/iframe in a second, different domain) that a web page designer may build into a window may not work properly across all web browser programs. As such, web pages may not work in their intended fashion when viewed by Internet users that employ web browser programs that place certain restrictions on cross-domain communications.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram illustrating how a web browser program may retrieve a web page from a remote server and display the web page to an Internet user.

FIG. **2** is a schematic diagram illustrating a web browser window having multiple iframes embedded therein that display web pages and other elements to a user.

FIG. **3** is a schematic diagram of a web browser window which contains a web page that is controlled by a first entity that illustrates an exemplary situation where a second entity may want to have the ability to interactively modify certain content on the web page.

FIG. **4** is a flow chart that illustrates a method for implementing communications between windows that is known as the URL polling technique.

FIG. **5** is a flowchart that illustrates another method for implementing communications between windows that is known as the postMessage technique.

FIG. **6** is a schematic block diagram illustrating how cross-domain communications between two windows may be implemented according to certain embodiments of the present disclosure.

FIG. **7** is a flowchart of operations for creating a target window that facilitates certain cross-domain communications according to embodiments of the present disclosure.

FIG. **8** is a flowchart of operations for conducting cross-domain communications between windows that are in different domains according to embodiments of the present disclosure.

FIG. **9** is an information flow diagram that further illustrates various methods of facilitating cross-domain communications pursuant to embodiments of the present disclosure.

FIG. **10** is a flowchart of operations for a sender window that is in a first domain to communicate with a target window that is in a second, different domain according to further embodiments of the present disclosure.

FIG. **11** is a flow chart of operations for conducting cross-domain communications according to further embodiments of the present disclosure.

FIG. **12** is a flow chart of operations for conducting cross-domain communications according to yet additional embodiments of the present disclosure.

FIG. **13** is a block diagram of a system for generating a target web browser window that is in a first domain that is configured to receive communications from a sender web browser window that is in a second, different domain according to embodiments of the present disclosure.

DETAILED DESCRIPTION

Methods, systems and computer program products are disclosed herein that may be used to facilitate secure cross-

domain communications between web browser windows. For example, a web page or other document may be rendered within a first web browser window (herein the "target window") on a display device. The target window is in a first domain that includes the server that supplied the web page that is displayed in the target window. The target window may include an embedded iframe or window such as, for example, a pop-up window, which may be populated with information from a second domain that is different than the first domain. This pop-up window may need to communicate with the target window and/or alter content that is displayed in the target window. Unfortunately, as discussed above, security features that are included in various web browser programs may prevent the pop-up window from doing so because the two windows are in different domains.

Pursuant to the techniques disclosed herein, an iframe (referred to as a "bridge iframe") may be created, for example, when the web page supplied from the first domain is loaded within the target window. The content of this bridge iframe—which is supplied from a second, different domain—is a function called the "SendMessageToParent" function that forwards a received message to the target window. The pop-up window is a "child" of the target window, as it was opened/created by the target window. Because the pop-up window is related to the target window (i.e., in a child-parent relationship), the pop-up window can find and gain access to the bridge iframe, even though the pop-up window and the target window (which is the parent of the bridge iframe) are associated with different domains. Additionally, as the bridge iframe is within the second domain (i.e., in the same domain as the pop-up window), the pop-up window can access or "call" the above-mentioned SendMessageToParent function of the bridge iframe, where the call of the function includes a message that is to be sent to the target window. The SendMessageToParent function of the bridge iframe forwards this message to the target window using conventional techniques for iframe-to-window communications. Thus, by embedding the bridge iframe within the target window, embodiments of the present disclosure may facilitate secure cross-domain communications between windows that are in different domains. Various embodiments will now be described in greater detail with reference to the figures.

FIG. **1** is a schematic block diagram illustrating how a web browser program may retrieve a web page or other content from a remote server for display on a computer or other processing device. As shown in FIG. **1**, an Internet user may have a first processing device **10** that is connected to a remote server **30** via one or more wired and/or wireless communications links. In the example of FIG. **1**, the processing device **10** is connected to the remote server **30** via a series of networks that include a wireless local area network ("WLAN") **42** that connects the processing device **10** to an Internet connection, the Internet **40**, and a local area network ("LAN") **44** that connects the remote server **30** to the Internet **40** and to various other associated hardware such as, for example, memory storage devices (not shown in FIG. **1**).

The processing device **10** may be any suitable device that has Internet communications capabilities, such as a personal computer, laptop computer, netbook computer, tablet computer, gaming system, smart phone, music player, personal digital assistant or the like. The processing device **10** may include a memory **12**, a processor **14**, input devices **16** (e.g., a keyboard, mouse, microphone, etc.) and a display **18**, along with numerous other components (not shown in FIG. **1**) such as wired or wireless network cards, additional output devices, operating systems, input/output ports, input/output port drivers, etc. that are commonly provided on Internet-enabled processing devices. The processing device **10** further includes a web browser program **20** that is stored in the memory **12**. Examples of commercially available and commonly used web browser programs **20** include Microsoft® Internet Explorer®, Google® Chrome®, Safari®, Firefox® and Opera®. The web browser program **20** may be executed on the processor **14**. It will also be appreciated that the web browser program **20** may be stored and/or executed from a location remote from the processing device **10**.

The web browser program **20** may be used to collect and render on the display **18** information that is stored, for example, on various remote servers such as remote server **30**. In the example of FIG. **1**, the remote server **30** is connected to processing device **10** via the Internet **40**, a WLAN **42** and a hard-wired LAN **44**. The user operating the processing device **10** may, for example, request information from remote server **30** over the Internet **40** by opening the web browser program **20**. Once the web browser program **20** is opened, the user may use one or more of the input devices **16** (e.g., a mouse and a keyboard) to input a URL such as, for example, http://www.xyz.com, into an input box that is displayed to the user via display **18**. The input URL acts as an electronic address that identifies to the web browser program **20** a location where, for example, a particular web page that the user wants to view may be found.

Each URL follows a defined format that includes a protocol portion, a domain name or Internet Protocol ("IP") address, an optional port number, a path (which identifies where the resource can be found), a query string (if appropriate), and an optional fragment identifier. Thus, a URL may have the following general format:

protocol://domain:port/path?query_string#fragment_id

The protocol defines the purpose of the remainder of the URL, with http, https and ftp being common protocols. The domain name (or IP address) identifies the destination location for the URL, which may be, for example, the IP address of a server that hosts the requested document. The port number, which is optional (since a default port is typically specified) identifies the port on the host server associated with the IP address to connect to. The path specifies where the requested document may be found on the host server. The query string contains data that may be passed to software running on the host server and, finally, the fragment identifier, specifies a section or location within the requested document so that the web browser program may scroll to display a specific part of the document.

Once the user enters the URL into the web browser program **20**, the web browser program **20** sends a request **50** over the networks **40**, **42**, **44** to a server or other processing device associated with the input URL (which, in the example of FIG. **1**, is the remote server **30**). In response to the request **50**, the remote server **30** may send a response **52** back to the processing device **10** that hosts the web browser program **20**. This response **52** may comprise, for example, one or more XML or HTML files that may be used by the web browser program **20** to generate or "render" a web page on the display **18** of processing device **10**. A layout engine of the web browser program **20** may then transform the response **52** (e.g., the XML or HTML files) into an interactive document that may be rendered to the user on the display **18** of the processing device **10** such as, for example, a web page **54**. Web pages such as web page **54** may include text, images, audio, video and embedded programs such as JavaScript applets. A web page **54** may also include JavaScript or other computer program code which may

allow the user (via the web browser program **20**) to interact with the server **30** that supplied the web page **54** to the user's web browser program **20**. This code may, for example, change the appearance of the rendered web page, open additional web pages or iframes, execute audio or video files and the like automatically and/or in response to input received from a user.

As is well known in the art, a web page such as web page **54** is typically rendered to a user within a web browser window **22** that is created by the web browser program **20** on the display **18** of processing device **10**. The web browser window **22** may comprise a single window, or may be sub-divided into (or otherwise include) multiple iframes, where each iframe may act like a sub-window and may contain its own web page, media element (e.g., video file) or the like. Pop-up windows may also be displayed by the web browser program **20**. A pop-up window refers to a second, typically smaller web browser window that may be partially or completely superimposed over (or under with respect to "pop-under" windows) an "initial" web browser window. Pop-up windows are routinely used to present advertisements or other information to a user. Pop-up windows can be an effective means for displaying information to the user because they typically are designed so that they do not disrupt the underlying web browser window. By way of example, a user who is filling out a form on a web page and needs additional guidance may select a "help" utility that renders a pop-up window that appears over the underlying window and next to the form that provides more detailed instructions for completing the form. This allows the user to access the more detailed instructions without reloading the underlying web page (which reload might result in the loss of some of the data entered into the form and/or cause the user to lose their place on a long web page), and can also be used to reduce the amount of data transmitted for web page navigation, thereby improving user access speeds.

FIG. **2** is a schematic diagram that illustrates typical content that may be displayed in a web browser window **100** that is rendered to a user within display **18** of processing device **10**. The web browser window **100** may have its own unique URL **102**, which may or may not be displayed to the user. A variety of objects may be embedded within the window **100**. These objects may include, for example, media elements such as videos **104**, banner advertisements **106**, widgets **108** and/or a variety of other objects known to those of skill in the art. A widget is an element of a graphical user interface that displays information or provides a specific way for a user to interact with a computer program such as an application or an operating system. Exemplary widgets include icons, pull-down menus, user-selectable buttons and/or boxes, progress indicators, scroll bars that allow a user to scroll horizontally or vertically to view content that does not fit on their display, window edges that allow a user to resize the window, toggle buttons, forms, and the like which display information and/or which invite, accept and/or respond to actions by a user. In FIG. **2**, several example widgets **108** are illustrated including scroll bars **108-1** and a button **108-2**. The window **100** may also include embedded JavaScript (not shown) that may carry out a variety of functions, including sending communications to other windows or iframes and/or receiving communications from other windows or iframes.

As shown in FIG. **2**, the window **100** may be divided into or otherwise include a plurality of iframes **110**, **112**, **114**. Each iframe **110**, **112**, **114** may, in effect, comprise a separate sub-window that may have the full functionality of a window, including a separate URL, the ability to scroll independently of other displayed windows, the ability to reload independent of other displayed windows, etc. Each iframe **110**, **112**, **114** is a "child" of the window **100**, and the window **100** comprises a "parent" of the iframes **110**, **112**, **114**. As is shown by the dotted line outlining iframe **114** in FIG. **2**, some iframes may be embedded within window **100** but not be visible to a user. In some cases (not shown), the window **100** may not be visible to a user, who will only see the individual iframes **110**, **112**. As shown in FIG. **2**, the window and the iframes **110**, **112** may each comprise a container that holds one or more things such as a web page, a media element, an advertisement or the like. In the example of FIG. **2**, a total of three web pages having distinct URLs are simultaneously displayed to the user in window **100** and iframes **110** and **112**.

Thus, as shown in FIG. **2**, a plurality of different web pages, media elements, advertisements and the like—some of which are independently controllable and some of which are not—may be simultaneously displayed to a user within a web browser window **100** and its associated iframes **110**, **112**.

There may be instances where a first entity has one or more widgets that are rendered on a web page that is controlled and operated by a second, different entity. As one simple example, the first entity may pay the second entity to include widgets on certain of its web pages that, when selected by a user viewing the web page, activate a pop-up window within the web browser window that includes, for example, a web page, form or other content provided by the second entity. This example is illustrated in FIG. **3**.

In particular, FIG. **3** illustrates a web browser window **200** ("the target window") which is provided on the display **18** of a processing device **10**. A web page **210** is rendered within the target window **200**. The files necessary to create web page **210** were provided to the web browser program **20** running on processing device **10** by a first remote server **30** that is run by the first entity. The first server **30** is part of a first domain **32**. The rendered web page **210** may, for example, comprise a "check-out" web page of an online merchant which initiates the process of collecting information from the user that is necessary to complete a purchase transaction. The web page **210** includes a widget **230** thereon in the form of a button. In this example, the widget/button **230** allows a user who is completing an online purchase of an item from the first entity to pay for that purchase via an account that the user has with a second entity. This second entity operates a second remote server **36** that is in a second, different domain **38**.

A user that is viewing the web page **210** may "activate" the button **230** (e.g., by pointing to it using a mouse and then clicking on the button **230**, pressing the button **230** when the web page **200** is displayed on a touch screen, etc.) to cause JavaScript code that is associated with the widget/button **230** to be executed that causes the web browser program **20** to, for example, create and populate a pop-up window **240** on the user's display **18**. This pop-up window **240** may be located adjacent to the target window **200** and/or partially or completely overlapping the target window **200**. The content displayed in the pop-up window **240** may be a web page, a form, etc. that is supplied by the second server **36** that is in the second domain **38**. By way of example, the content displayed in the pop-up window **240** may be an interactive log-in screen **242** that the user can fill in to log into an account that the user has with the second entity.

There may be reasons for communicating information from the pop-up window **240** back to the target window **200**. As one simple example, the user may enter address infor-

mation into the pop-up window **240** as part of the payment process. It may be desirable to communicate this address information back to the target window **200**. As another example, it may be desirable for the pop-up window **240** to close the target window **200** (or an iframe thereof) at some point during the payment process. In order to accomplish these tasks, it is necessary to have a means for the pop-up window **240** to communicate with the target window **200**.

FIG. **4** is a flow chart that illustrates one conventional method for implementing cross-domain communications between two windows that is known as the URL polling technique. As shown in FIG. **4**, with this technique, a first window (e.g., the pop window **240** of FIG. **3**) can send a message to a second window (e.g., the target window **200** of FIG. **3**) by appending the communication to the URL fragment identifier (hash location) of the second window (block **300**). The second window **200** periodically polls the value of its URL to detect if any changes have been made thereto (block **305**). If at block **310** the second window **200** detects a change to its URL, operations proceed to block **315** where the second window **200** extracts the message that has been appended to URL. If the URL remains unchanged, the periodic polling of the URL at block **305** continues. This "URL polling" method provides a simple mechanism for a first window or iframe to send messages to a second window or iframe, even though the windows/iframes may belong to different domains. While this technique still works with, for example, the FireFox web browser program, most other major web browsers have installed security routines that prevent an iframe or window associated with a first domain from tampering with the URL of an iframe or window that is associated with a different second domain. Consequently, if the pop-up window **240** of FIG. **3** is associated with a different domain than the target window **200**, then most web browser programs will no longer allow the pop-up window **240** to use the URL polling technique to send a message to the target window **200**.

FIG. **5** is a flow chart that illustrates another conventional method for implementing cross-domain communications between windows that is known as the postMessage technique. The postMessage technique became available with the implementation of HTML 5 standard. As shown in FIG. **5**, under the postMessage technique, operations for a cross-domain communication may begin by JavaScript in the window that is to receive the cross-domain communication (e.g., the target window **200** of FIG. **3**) creating an event handler such as, for example, an event listener that listens for incoming messages (block **350**). An event listener is a software element that distributes data to objects that register to receive the data corresponding, for example, to the detection of specific events from specific sources. Next, JavaScript in a "sending" window (e.g., the pop-up window **240** of FIG. **3**) calls a "postMessage" event on the target window **200** (block **355**). This postMessage call causes a message event to be sent to the target window **200** that is marked as originating from the document rendered in the pop-up window **240** (block **360**). When the message is received at the target window **200**, JavaScript in the target window **200** (which may be the event listener) checks the source domain of the message to confirm that the message is from an expected source domain (block **365**). If it is not, the message may be discarded (block **370**). If the message is from an expected source domain, JavaScript (e.g., the event listener) in the target window may (optionally) perform additional security checks, such as, for example, confirming that data contained in the received message has an expected format (block **375**). If it does not, the message may be discarded (block **370**). If the received message passes these additional security checks, then the communication may be passed to the target window **200** and/or allowed to alter the target window **200** (block **380**).

Unfortunately, not all web browser programs support postMessage calls for cross-domain window-to-window communications. Consequently, in the example of FIG. **3** above where a window that is associated with a first domain is seeking to communicate with a window that is associated with a second domain, the postMessage technique will not work for all web browser programs. Consequently, neither the postMessage technique nor the URL polling technique will work across all major web browser programs as a technique for implementing cross-domain window-to-window communications.

FIG. **6** is a schematic block diagram illustrating how cross-domain communications between two windows may be implemented according to certain embodiments of the present disclosure. As shown in FIG. **6**, a first web browser window **400** is rendered on a user's display device **18**. A first web page **410** having URL www.abc.com is rendered in the first window **400**. In the example of FIG. **6**, the first window **400** is the window that is to receive a message, and hence is also referred to as the "target" window in the description that follows.

As shown in FIG. **6**, the target window **400** includes an embedded iframe **420**. In this example, the iframe **420** is not visible to the user, and hence is shown using dotted lines in FIG. **6**. The iframe **420** may be created, for example, by JavaScript contained within the target window **400** during the load of a web page **410** that is contained in the target window **400**, or at a later time. The iframe **420** is a software browsing context that is nested within the target window **400**. The iframe **420** has a source or "src" address of www.xyz.com, meaning that the content of the iframe **420** was provided from the www.xyz.com domain. The iframe **420** is referred to herein as a "bridge iframe" as it is used as a bridge to facilitate cross-domain communications between a second window **430** and the target window **400**, in the manner described below. The content of the bridge iframe **420** is a JavaScript function **422** named SendMessageToParent, that is designed to take an input message and forward that message to the target window **400** using, for example, either the postMessage or URL polling techniques that are discussed above with reference to FIGS. **4** and **5** (whichever one is appropriate based on the web browser program that is used to render the windows/iframes).

As shown in FIG. **6**, the target window **400** further includes an event listener **450**. Event listener **450** may comprise, for example, JavaScript code that detects events such as postMessage calls. Various functions that may be performed by the event listener **450** are discussed below.

As is further shown in FIG. **6**, a second web browser window **430** is also displayed on the user's display device **18**. The second window **430** may comprise, for example, a pop-up window **430** that is rendered adjacent to or overlaying the window **400**. The pop-up window **430** may be created by the web browser program **20** (not shown in FIG. **6**, see FIGS. **1** and **3**) in response to JavaScript code in the target window **400** (e.g., the target window **400** receives input from a user, such as activation of a widget, that causes JavaScript code to be executed that instructs the web browser program **20** to create pop-up window **430**). In this example, the pop-up window **430** has a URL of www.xyz.com. Thus, the windows **400** and **430** are associated with different domains, and hence various web browser programs may not allow these windows **400** and **430** to

communicate with each other. The bridge iframe **420** is embedded in the target window **400**, which is in the www.abc.com domain, but the bridge iframe **420** is in the www.xyz.com domain (i.e., the same domain as the pop-up window **430**), as the contents of the bridge iframe **420** were provided from the www.xyz.com domain.

The pop-up window **430** is a child window of the target window **400**. By way of background, a "child" window (or iframe) refers to a window/iframe that is created or opened by another "parent" window, either automatically or as a result of some activity of a user who is viewing the parent window. A child window and a parent window are considered to be "related" to each other. Two child windows of the same parent window would also be related to each other (as sibling windows), and the relationships can extend across more than one or two generations (i.e., a parent and a grandchild window would be related to each other, as would two grandchild windows that have different parent windows but the same grandparent window). The existence of a relationship between windows/iframes from different domains is relevant because web browser programs generally will allow a first window to have access to all of the iframes of a second window—even if the first and second windows are from different domains—so long as the first and second windows are "related" to each other in the manner described above.

As the target window **400** and the pop-up window **430** are related to each other as parent and child, the pop-up window **430** can find and gain access to (i.e., "grab a handle to") any of the iframes of the target window **400**, specifically including the bridge iframe **420**, even though the target window **400** and the pop-up window **430** are in different domains.

Additionally, as the bridge iframe **420** is within the www.xyz.com domain, which is the same domain as the domain of the pop-up window **430**, the pop-up window **430** can access the SendMessageToParent function **422** of the bridge iframe **420** in order to communicate with the target window **400**. In particular, the pop-up window **430** can call the SendMessageToParent function **422** of the bridge iframe **420**, which will pass a communication **440** from the pop-up window **430** to the target window **400**.

The SendMessageToParent function **422** may be configured to forward the message **440** from the pop-up window **430** to the target window **400** using, for example, one of the above-described postMessage and URL polling techniques. As noted above, if the postMessage technique is used, the bridge iframe **420** may call a postMessage event on the target window **400**. The event listener **450** at the target window **400** detects the postMessage call, and may then perform one or more security checks on the message **440** that is being forwarded from the bridge iframe **420** to determine whether or not the message **440** should be discarded or not. In particular, the event listener **450** may scan each postMessage communication to ensure that it complies with the HTML 5 specifications, and only allow complying postMessage events to occur. While the SendMessageToParent function **422** of the bridge iframe **420** and the target window **400** are associated with different domains, cross-domain communications therebetween are generally allowed under the postMessage technique as such communications comprise iframe-to-window (as opposed to window-to-window) communications.

As some web browsers do not support the postMessage technique, the target window **400** may also be set up to periodically poll its URL location for the value of the URL fragment identifier. For web browsers that do not support the postMessage technique, the bridge iframe **420** may be configured to modify the URL fragment identifier of the target window **400** so as to append the message from the pop-up window **430** thereto. Such modification to the URL is permitted as the bridge iframe **420** is related to the target window **400** (i.e., it is a child of the target window **400**).

Thus, by embedding the bridge iframe **420** within the target window **400**, the pop-up window **430** is provided a mechanism by which it can send a message **440** to the target window **400**.

FIG. **7** is a flowchart of operations for creating a target window that is designed to receive certain cross-domain communications according to embodiments of the present disclosure. As shown in FIG. **7**, operations may begin with a user requesting a desired web page via a web browser program (i.e., by typing in the URL for the web page, selecting a hyperlink, etc.) (block **500**). In response to this request, the web browser program sends a request to a server in a first domain that is associated with the requested web page (block **505**). The server forwards one or more files to the web browser program that can be used by the web browser program to create the requested web page (block **510**). The web browser program then opens a window (the "target window") on the user's display device (block **515**), and renders the requested web page within the target window (block **520**). The web page may have a widget or other object embedded therein that is configured to create a window or iframe such as a pop-up window that is rendered adjacent to the target window. This pop-up window may be created, for example, in response to input received from a user viewing the web page. The pop-up window (or other window or iframe) may receive content (e.g., a second web page, a log-in screen, a form, etc.) from a device (e.g., a server) that is associated with a second domain that is different than the first domain. The requested web page that is displayed in the target window also has embedded JavaScript code (or other computer program code) therein that executes, for example, during the load of the requested web page within the target window that creates a bridge iframe (block **525**). The source address of the bridge iframe may be in the second domain, and the content of the bridge iframe may be the SendMessageToParent function. As discussed above, the pop-up window may use the SendMessageToParent function of the bridge iframe to communicate with the target window.

FIG. **8** is a flowchart of operations for conducting cross-domain communications between windows from different domains according to embodiments of the present disclosure. The operations of FIG. **8** may be carried out, for example, after completion of the operations of the flow chart of FIG. **7**.

As shown in FIG. **8**, operations may begin with a user that is viewing the web page that is rendered in the target window activating a widget (or other object, icon, etc.) displayed thereon (block **530**) by, for example performing a mouse click on the widget. Activation of the widget (or other object, icon, etc.) invokes a JavaScript routine that causes the web browser program to create and display a pop-up window (block **535**). The pop-up window may contain content that is provided from a domain that is different than the domain that supplied the content to the target window. As an example, the pop-up window may display a web page of an entity that includes a log-in screen, and the user may log into their account with the entity using this log-in screen. The user may then interact with the entity by, for example, logging into their account with the entity and providing information to the entity (block **540**). The pop-up window may convey information that is entered by the user to a remote server in

the domain of the pop-up window (block **545**). A number of different communications may be exchanged between the pop-up window and the remote server, and various different web pages may be displayed in the pop-up window during this exchange. Thereafter, the pop-up window may invoke the SendMessageToParent function of the bridge iframe in order to pass information and/or send a message to the target window (block **550**). In response to this function call, the bridge iframe may use, for example, either the postMessage technique or URL polling to forward the information/message to the target window (block **555**) using the processes described above with respect to FIGS. **4** and **5**. As shown in FIG. **8**, if the postMessage technique is used, an event listener in the target window may detect the message and make a determination as to whether or not the message should be provided to an event processor associated with the target window in the manner described above with respect to FIG. **5**.

FIG. **9** is an information flow diagram that further illustrates various operations and/or methods of facilitating cross-domain communications pursuant to embodiments of the present disclosure. In particular, the information flow diagram of FIG. **9** shows various message and file/data transfers that may occur in order to allow the pop-up window **430** of FIG. **6** to communicate with the target window **400** of FIG. **6** after, for example, a user starts interacting with the pop-up window **430**.

As shown in FIG. **9**, operations may begin with a user of the processing device **10** using one or more of the user input devices **16** (see FIG. **1**) to request a specific web page **410** by, for example, typing a URL into the web browser program **20** or by selecting a hyperlink (block **600**). This request for the web page **410** is transferred from the user input device **16** to the web browser program **20** that is operating on processing device **10**. Upon receiving this request, the web browser program **20** contacts a server that is identified in the input URL to request the files necessary to generate the requested web page (block **605**). In this particular example, the server is a remote server **30** (see FIG. **3**) that is in the www.abc.com domain **32**. In response to the request **605**, the server **30** returns one or more files such as HTML files to the web browser **20** that may be used to create the requested web page **410** (block **610**).

The web browser program **20** creates the target window **400** in which the requested web page **410** will be displayed. The web browser program **20** receives the requested files (block **615**), and uses these files to create the requested web page **410** (block **620**), and the displays the requested web page **410** within the target window **400** (block **625**). As discussed above with respect to FIG. **6**, the web page **410** includes a widget **230** that the user may activate in order to, for example, log-in to a website and/or account of another entity that is associated with another remote server (namely server **36** of FIG. **3**, which is in the www.xyz.com domain **38**).

The user activates the widget **230** by, for example, pointing at the widget **230** using a mouse and then clicking the left button of the mouse (block **630**). A JavaScript routine that is associated with the widget **230** is executed in response to this mouse click. Execution of this JavaScript routine causes the web browser **20** to request files from the remote server **36** in the www.xyz.com domain that will be used to populate a pop-up window **430** that will be created over top of the target window **400** (block **635**). In response, the remote server **36** sends the requested files to the web browser program **20** (block **640**). The web browser program **20** receives the files (block **645**), and then creates the pop-up window **430** (block **650**) and uses the received files to render the requested web page **242** within the pop-up window **430** (block **655**). In this particular example, the web page **242** comprises a log-in screen for a website in the domain **38**.

The user may use the input devices **16** to input log-in information into the log-in screen (block **660**), thereby logging into their account so that a customer service session is initiated (block **665**). The pop-up window **430** may pass information back to the remote server **36** in the www.xyz-.com domain, and various information may be exchanged between the pop-up window and the remote server **36** (blocks **670**). The interaction/information exchange between the pop-up window **430** and the remote server **36** may include passing additional web pages to the pop-up window **430** (not shown in FIG. **9**) that are displayed in the pop-up window **430**. Thereafter, the pop-up window **430** may need to to send a message to the target window **400** such as, for example, an instruction to close the target window **400** or an iframe thereof or transfer of address information in our example). In some cases, the remote server **36** may instruct the pop-up window **430** to send the message to the target window **400**. When such a need to send a message arises, JavaScript code within the pop-up window **430** invokes the SendMessageToParent function **422** of the bridge iframe **420** (block **675**). In response to the call of this function **422**, the bridge iframe **420** forwards the message from the pop-up window **430** to the target window **400** using either (1) the postMessage technique or (2) URL polling, as appropriate (block **680**) so that the message is received at the target window (block **685**). An event listener may monitor for any postMessage calls in the manner discussed above (not shown in FIG. **9**).

As shown above, the techniques according to embodiments of the present disclosure may facilitate secure window-to-window and/or iframe-to-window cross-domain communications across various web browser programs. Embodiments of the present disclosure take advantage of the fact that web browser programs generally allow a sender window (e.g., the pop-up window **430**) to have access to the iframes within a target window (e.g., target window **400**), even if the sender pop-up window **430** and the target window **400** are in different domains, so long as the sender window and the target window are related to each other. Thus, as the pop-up window **430** is a child of the target window **400**, the pop-up window **430** is permitted access to the iframes within the target window **400**, specifically including the bridge iframe **420**, even though the pop-up window **430** and the target window **400** are associated with different domains. Because the pop-up window **430** is permitted access to the iframes of the target window **400**, the pop-up window **430** can grab a handle to the bridge iframe **420**.

Embodiments of the present invention also take advantage of the fact that direct iframe-to-window and window-to-window communications are generally allowed by web browser programs so long as both the sending iframe/window and the target window are from the same domain. As such, the pop-up window **430** can access the SendMessageToParent function **422** of the bridge iframe **420** as the pop-up window **430** and the function **422** of the bridge iframe **420** share a common domain. The SendMessageToParent function **422** of the bridge iframe **420** may use, for example, the postMessage or URL polling techniques to forward a message from the pop-up window **430** that is contained in the function call to the target window **400**.

Thus, pursuant to embodiments of the present disclosure, documents (e.g., web pages, forms, etc.) that are from

different domains can communicate with each other, without exposing the documents to hostile cross-site scripting attacks.

FIG. **10** is a flowchart of operations for a sender window that is within a first domain to communicate with a target window that is within a second, different domain according to further embodiments of the present disclosure. As shown in FIG. **10**, operations may begin with the target window creating an embedded iframe that has a source address that is within the first domain (i.e., in the domain of the sender window) (block **700**). Next, a function of the embedded iframe may be invoked in response to a function call from the sender window (block **705**). A message may thereafter be received at the target window in response to the invocation of the function of the iframe that is passed from the sender window to the target window via the iframe (block **710**). The sender window may be a child window of the target window.

In some embodiments, the sender window may be a pop-up window. In some embodiments, the message may be received at the target window after the iframe makes a postMessage call on the target window or after the iframe appends the message to the URL of the target window.

FIG. **11** is a flow chart of operations for conducting cross-domain communications according to further embodiments of the present disclosure. As shown in FIG. **11**, operations may begin with a document being generated and loaded into a first web browser window that is in a first domain (block **720**). The document may comprise, for example, a web page, a form, a media element, etc. The loaded document may include a trigger (block **725**), where a trigger refers to an object or other element that a user may select or activate to cause a responsive action. In some embodiments, the trigger may comprise a user-activated widget. An iframe that is a child of the first web browser window and that is in a second, different domain is also generated (block **730**). The user-activated widget, when activated by a user, executes computer program code such as JavaScript that causes a second web browser window to be created and populated (block **735**). This second web browser window may be related to the first web browser window, and may be in the second domain. Thereafter, a message may be received at the first web browser window that is forwarded from the second web browser window to the first web browser window via the iframe (block **740**).

FIG. **12** is a flow chart of operations for a sender web browser window that is in a first domain to communicate with a target web browser window that is in a second, different domain according to further embodiments of the present disclosure. As shown in FIG. **12**, operations may begin with the creation of the target web browser window that is in the second domain (block **750**) and the creation of the sender web browser window that is in the first domain (block **755**). During the creation of the target web browser window (which is in the second domain), an embedded bridge iframe may be created that is in the first domain. Thereafter, the sender web browser window may grab a handle to the bridge iframe (block **760**). Once the sender web browser window has the handle to the bridge iframe, it may invoke a function of the bridge iframe in order to forward a message to the target web browser window from the sender web browser window via the bridge iframe (block **765**). The iframe and the sender web browser window may each be a child of the target web browser window. The function of the iframe may use, for example, the postMessage technique or the URP polling technique to forward the message to the target web browser window.

FIG. **13** is a block diagram of a system **800** for generating a target web browser window that is in a first domain that is configured to receive communications from a sender web browser window that is in a second, different domain according to embodiments of the present disclosure. As shown in FIG. **13**, the system includes a first module **810** that is configured to generate the target web browser window, the target web browser window including a user-activated object therein (e.g., a widget). The system further includes a second module **820** that is configured to generate a bridge iframe that is embedded in the target web browser window and that is a child of the target web browser window, the bridge iframe being in a second domain that is different from the first domain. The system also includes a third module **830** that is configured to generate a sender web browser window (e.g., a pop-up window) that is a child of the target web browser window in response to activation of the user-activated object, the sender web browser window also being in the second domain. In some embodiments, the second module **820** is configured to generate the bridge iframe to have as its content a function that is configured to forward a message received from the sender window to the target window using, for example, the postMes sage technique or the URP polling. It will be appreciated that the modules **810**, **820**, **830** may be implemented separately or may be combined together.

While certain embodiments of the present invention have been described above, it will be appreciated that numerous modifications may be made to the described embodiments without departing from the scope of the present disclosure. As one example, it will be appreciated that the techniques of the present disclosure may be used to pass any message or information from a sender window that is in one domain to a target window that is in another domain. Thus, it will be appreciated that the above examples are simply exemplary in nature.

Herein, references are made to "using a computer" to perform various operations. It will be appreciated that the computer may any type of electronic processing element such as, for example, a microprocessor of a server, a general purpose computer or special purpose computer, a microcontroller, a digital signal processor, firmware, or any other computer processing device and may be standalone and/or connected by a wired and/or wireless, real and/or virtual, public and/or private network to additional computers. The network(s) discussed herein may be any public and/or private, virtual and/or real, wired and/or wireless network or combination of networks, specifically including the Internet.

While various embodiments have been described above, it will be appreciated that the disclosed embodiments are not intended to be limiting, and are only provided by way of example, and that the present application covers all modifications, equivalents, and alternatives falling within the spirit and scope of the claims appended hereto.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises," "comprising," "includes," "including," "have," "having" or variants thereof when used herein, specify the presence of stated features, operations, elements, and/or devices, but do not preclude the presence or addition of one or more other features, operations, elements, devices, and/or groups thereof. Moreover, when an element is referred to as being "responsive" or "connected" to another element or variants

thereof, it can be directly responsive or connected to the other element, or intervening elements may be present. In contrast, when an element is referred to as being "directly responsive" or "directly connected" to another element or variants thereof, there are no intervening elements present. As used herein the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these terms are only used to distinguish one element from another and are not limiting. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element without departing from the teachings of the disclosure. Moreover, although some of the diagrams include arrows on communication paths to show a primary direction of communication, it is to be understood that communication may occur in the opposite direction to the depicted arrows.

Various embodiments are described herein with reference to block diagrams and/or flowchart illustrations of computer-implemented methods, apparatus (systems and/or devices) and/or computer program products. It will be understood that a block of the block diagrams and/or flowchart illustrations, and combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions that are performed by one or more computer processing devices. These computer program instructions may be provided to a processor circuit of a general purpose computer circuit, special purpose computer circuit, and/or other programmable data processing circuit to produce a machine and/or a computer-implemented process, such that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, transform and control transistors, values stored in memory locations, and/or other hardware components within such circuitry to implement the functions/acts specified in the block diagrams and/or flowchart block or blocks, and thereby create means (functionality) and/or structure for implementing the functions/acts specified in the block diagrams and/or flowchart block(s). Accordingly, embodiments according to the present disclosure may be embodied in hardware and/or in software (including firmware, resident software, micro-code, etc.) that runs on a processor such as a digital signal processor, which may collectively be referred to as "circuitry," "a module" or variants thereof.

These computer program instructions may also be stored in a tangible computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instructions which implement the functions/acts specified in the block diagrams and/or flowchart block or blocks.

Tangible, non-transitory computer-readable mediums that may be used may include, for example an electronic, magnetic, optical, electromagnetic, or semiconductor data storage system, apparatus, or device. More specific examples of the computer-readable medium would include the following: a portable computer diskette, a random access memory (RAM) circuit, a read-only memory (ROM) circuit, an erasable programmable read-only memory (EPROM or Flash memory) circuit, a portable compact disc read-only memory (CD-ROM), and a portable digital video disc read-only memory (DVD/Blu-Ray).

It should also be noted that in some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Moreover, the functionality of a given block of the flowcharts and/or block diagrams may be separated into multiple blocks and/or the functionality of two or more blocks of the flowcharts and/or block diagrams may be at least partially integrated. Finally, other blocks may be added/inserted between the blocks that are illustrated and/or blocks may be omitted in some circumstances.

Various different embodiments have been disclosed above in connection with the description and the drawings. It will be understood that it would be unduly repetitious and obfuscating to literally describe and illustrate every combination and subcombination of these embodiments. Accordingly, the present specification, including the drawings, shall be construed to constitute a complete written description of all combinations and subcombinations of the embodiments described herein, and of the manner and process of making and using them, and shall support claims to any such combination or subcombination.

In the drawings and specification, there have been disclosed embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

The invention claimed is:

1. A system, comprising:

a first server that operates in a first domain and hosts a web page, the web page including functionality for performing a checkout transaction with a first entity, the web page including a display element that is selectable by a user, when the page is loaded in a target window of a browser, to initiate a payment transaction in support of the checkout transaction using an account with a second entity, the target window corresponding to the first domain;

wherein the web page includes (1) script coding that is responsive to user selection of the display element in the target window by opening a child window that provides functionality for the user to interact with a second server to execute a payment transaction using the account with the second entity, the second server operating in a second domain different from the first domain and hosting content for accessing the account with the second entity and performing payment transactions, the child window corresponding to the second domain, and (2) script coding that creates a bridge iframe configured to pass a message from the child window to the target window, the bridge iframe thereby supporting cross-domain communications between windows;

wherein the child window is configured to place a call to a message passing function of the bridge iframe, the call including the message, and the message passing function is responsive to the call by passing the message to the target window.

2. The system of claim **1**, wherein the second server hosts an interactive log-in screen that enables the user to log into the account using the child window.

3. The system of claim **1**, wherein the child window is configured to pass to the target window, via the bridge iframe, address information entered by the user into the child window.

4. The system of claim 1, wherein the child window is configured to pass to the target window a message that causes the target window to close.

5. The system of claim 1, wherein the child window is configured to pass to the target window a message that causes an iframe of the target window to close.

6. The system of claim 1, wherein the message passing function of the bridge iframe uses uniform resource locator polling to pass the message to the target window.

7. The system of claim 1, wherein the child window is a pop-up window.

8. The system of claim 1, wherein the web page further includes an event listener that listens for a message posting event generated by the bridge iframe.

9. A first server that operates in a first domain and hosts an electronic page that includes functionality for a user to perform a checkout transaction with a first entity using an account of the user with a second entity, the page comprising:

a display element that is capable of being activated by the user when the page is loaded in a target window of a browser, the target window corresponding to the first domain;

script coding that is responsive to user activation of the display element in the target window by opening a child window that provides functionality for the user to interact with a second server in a second domain to execute a payment transaction using the account with the second entity, the second window corresponding to the second domain, and

script coding that creates an iframe configured to pass a message from the child window to the target window, the iframe thereby supporting cross-domain communications between windows;

wherein the child window is configured to place a call to a message passing function of the iframe, the call including the message, and the message passing function is responsive to the call by passing the message to the target window.

10. The first server of claim 9, wherein the child window is configured to pass to the target window, via the iframe, address information entered by the user into the child window.

11. The first server of claim 9, wherein the child window is configured to pass to the target window a message that causes the target window to close.

12. The first server of claim 9, wherein the child window is configured to pass to the target window a message that causes an iframe of the target window to close.

13. The first server of claim 9, wherein the message passing function of the iframe uses uniform resource locator polling to pass the message to the target window.

14. The first server of claim 9, wherein the child window is a pop-up window.

15. The first server of claim 9, wherein the page further includes an event listener that listens for a message posting event generated by the iframe.

16. A non-transitory computer-readable medium having stored therein executable code that instructs a user computing device to implement a process comprising:

displaying a document in a first browser window associated with a first domain, the document associated with a first entity and including functionality for performing a transaction with the first entity, the document including a display element that is selectable by a user to initiate a payment process using an account with a second entity;

generating a second browser window in response to user selection of the display element of the document, the second browser window being associated with a second domain and second entity, the second browser window providing functionality for the user to use the account with the second entity to make a payment in support of the transaction;

loading the second window with content retrieved from a server in the second domain, said content providing functionality for the user to log into the account; and

generating an iframe that is configured to relay a message from the second browser window to the first browser window, the iframe thereby supporting cross-domain communications between browser windows;

wherein the second browser window is configured to place a call to a message passing function of the iframe, and the message passing function is responsive to the call by passing the message to the first browser window.

17. The computer-readable medium of claim 16, wherein the second window is a child of the first window.

18. The computer-readable medium of claim 16, wherein the second window is configured to pass to the first window, via the iframe, address information entered by the user into the second window.

19. The computer-readable medium of claim 16, wherein the message passing function of the iframe uses uniform resource locator polling to pass the message to the first browser window.

20. The computer-readable medium of claim 16, wherein the document further includes an event listener that listens for a message posting event generated by the iframe.

21. The system of claim 1, wherein the message passing function of the bridge iframe is configured to append the message to a uniform resource locator fragment of the target window, and the target window is configured to poll a value of the uniform resource located to detect a change in the value.

22. The system of claim 1, wherein the message passing function uses either a postMessage process or a uniform resource locator polling process to pass the message to the target window, depending upon a capability of a browser used to display the web page.

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